

Power Transmission and Distribution

# Cradle-to-Grave SF<sub>6</sub> Inventory Methodology

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CAPIEL EURELECTRIC



## What is CAPIEL ?

**CAPIEL:** Coordinating Committee for the Associations of Manufacturers of Industrial Electrical Switchgear and Controlgear in the European Union

**Member countries:** Belgium, Denmark, Germany, Greece, Spain, France, Ireland, Italy, Luxembourg, the Netherlands, Austria, Portugal, Finland, Sweden, United Kingdom.

**Total turnover:** 18.25 billion € (export 25 %)

**Employees:** around 118.000 in Europe

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## What is EURELECTRIC ?

**eurelectric:** The "Union of the Electricity Industry- EURELECTRIC" is the association which represents the common interests of the electricity industry at pan-European level plus its worldwide affiliates and associates. The association was formed as a result of a merger in December 1999 of the twin sector bodies UNIPEDA and EURELECTRIC.

**Members:** Currently there are 32 Full Members of EURELECTRIC, including all 15 EU Member States and all current candidate countries negotiating to join the Community.

**Installed  
total power: 700,000. MegaWatt** (Source: [www.eurelectric.org](http://www.eurelectric.org))

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# Kyoto Summit 1997: Greenhouse Gases



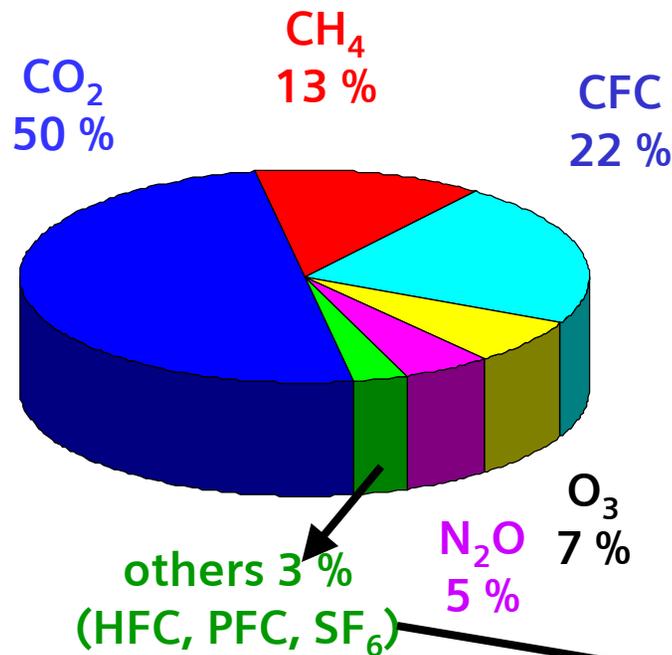
## Kyoto summit on climate change:

### – 1<sup>st</sup> group of greenhouse gases:

- Carbon dioxide (CO<sub>2</sub>) from burning of fossil fuels
- Methane (CH<sub>4</sub>) from intensive cattle farming
- Dinitrogen monoxide (N<sub>2</sub>O) from nitrogen fertilization

### – 2<sup>nd</sup> group of greenhouse gases:

- Hydrofluor carbons (HFC)
- Perfluor carbons (PFC)
- Sulfur hexafluoride (SF<sub>6</sub>)



Contribution of various gases to the greenhouse effect

(Source: BMU, Kyoto summit on climate change 1997)

Reduction of the emission in Europe: 8 % (basis 1990/95) until 2010

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# Kyoto Summit 1997: Greenhouse Gases



- The contribution of SF<sub>6</sub> - emission from Electricity Sector to man made global warming is less than 0,1%. European Electricity Sector contributes only 0,008 % .
- However, European switchgear manufacturers and users are aware that SF<sub>6</sub> is a persistent gas.
- Therefore, use and emission of SF<sub>6</sub> in electrical switchgear shall be controlled.
- Voluntary agreements are signed by CAPIEL and EURELECTRIC in 2001 to contribute to the European Climate Change Program (ECCP).

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## European Union ECCP (1)

### Objective:

identify and develop elements for an EU climate change strategy necessary for implementation of Kyoto Protocol

### Concentrate on:

- improvement of inventories and emission data
- developing measures for emission reductions
- developing policies to ensure reductions will be achieved

### Parties involved:

- European Commission
- Member States
- industries
- (E)NGO's

### Time scale:

- start summer 2000
- agreed policies and measures ready spring 2001

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## European Union ECCP (2)

### Final Report on Fluorinated Gases, June 2001

#### Sector specific aspects:

##### Production & Use of SF<sub>6</sub> switchgear:

- Emissions slightly decrease, despite projected increase of 50 % in population
- Monitoring and verification put in place
- Reduction options by voluntary actions initiated by the sector

##### Policies and Measures discussed for E-sector:

- Consolidation of monitoring system
- Formal recognition of voluntary European action to provide framework for flexible national targets

##### EU Legislation now in preparation, comprising:

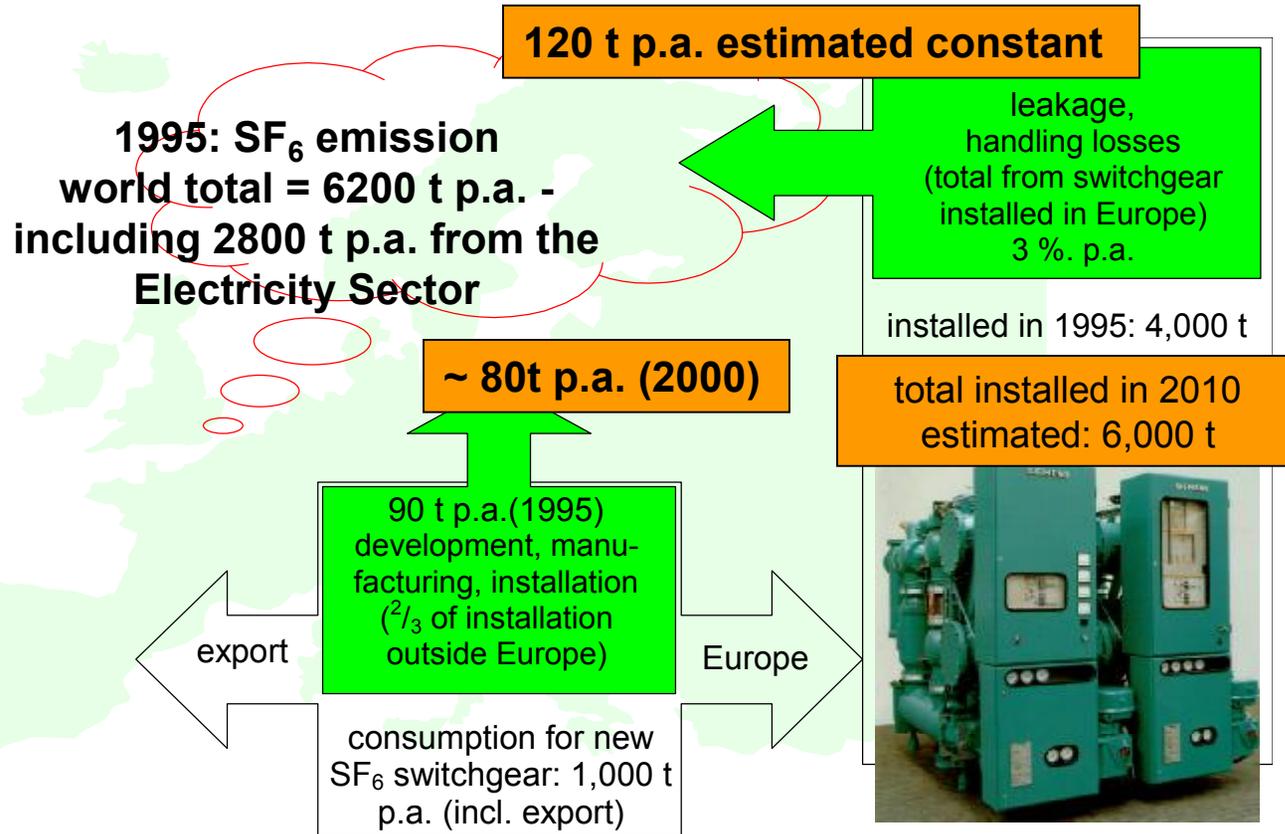
- Containment and monitoring
- Marketing and use restrictions for certain application as SF<sub>6</sub> in tyres, sound insulating glazing and sport shoes.

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# SF<sub>6</sub> and switchgear technology: Situation in the EU 15 (1995 and 2000)



## Emissions from the European Switchgear Industry (manufacturers and users)

1995: < 210 t p.a. ----> 2000: < 200 t p.a.

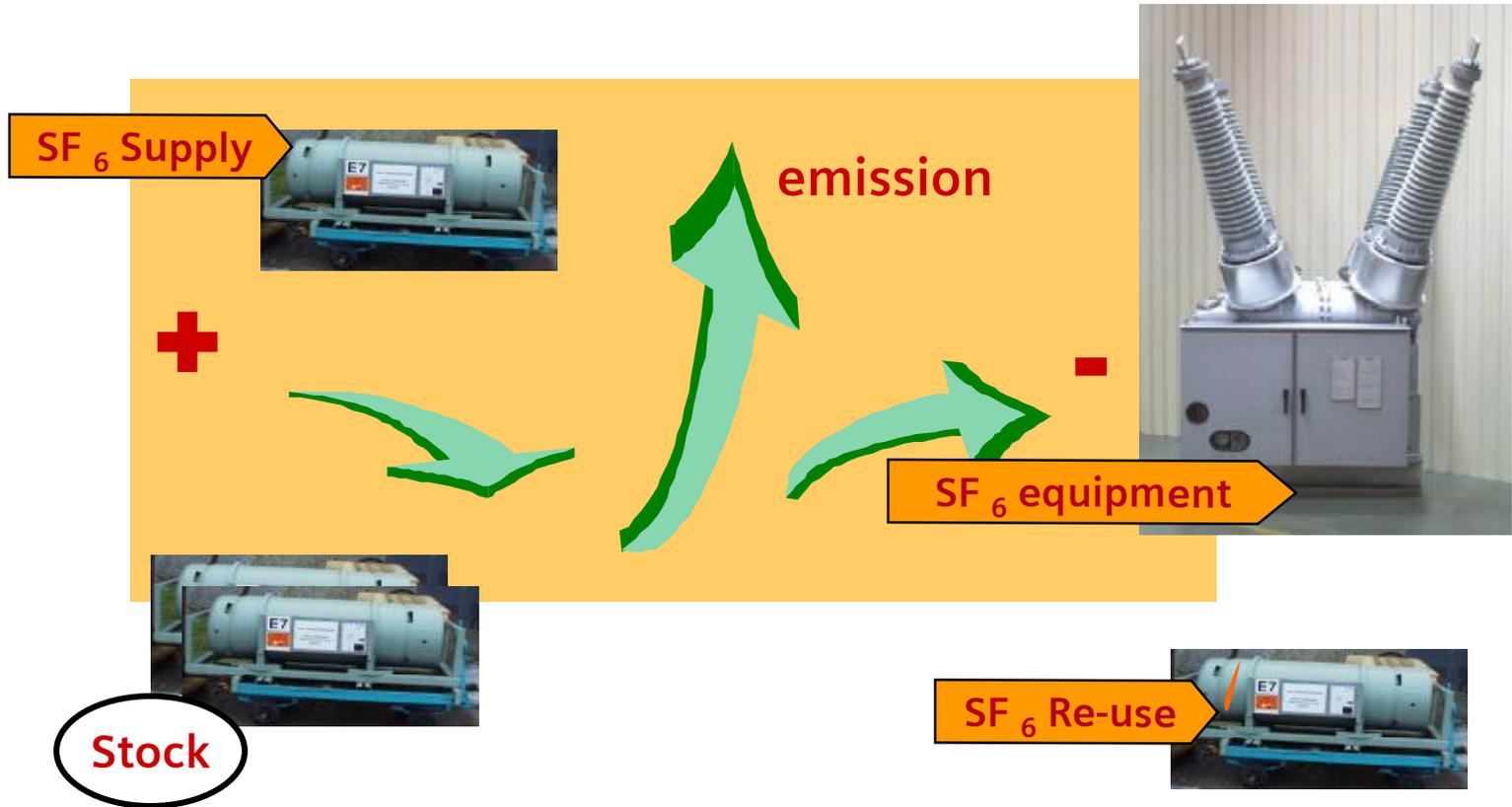
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# CAPIEL Inventory Methodology (1)

## Annual Assessment of SF<sub>6</sub>- quantities at OEMs



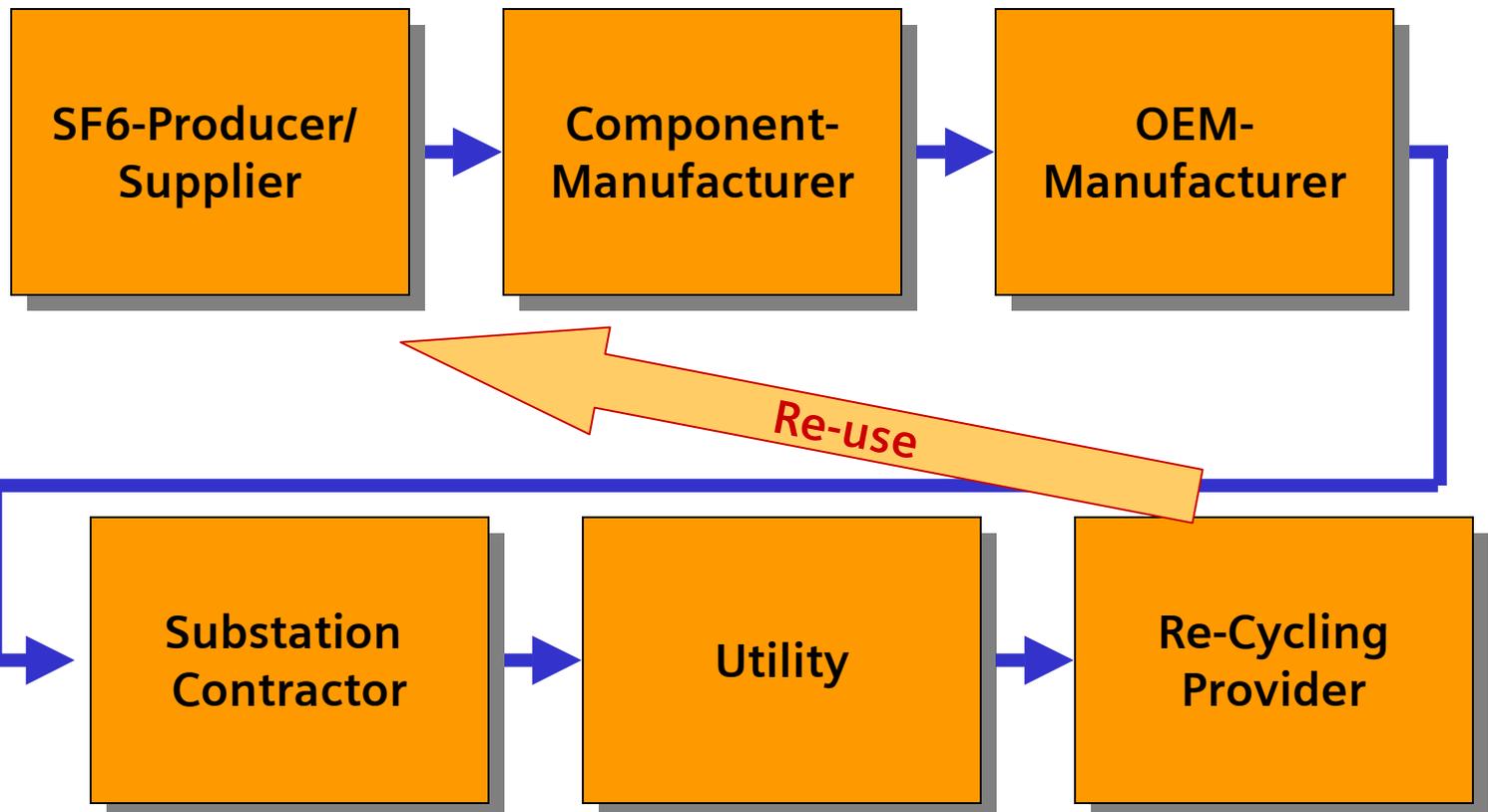
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$$\underline{\text{SF}_6 \text{ Input}} - \underline{\text{SF}_6 \text{ Output}} \pm \text{Delta Stock} = \underline{\text{SF}_6 \text{ Emission}}$$

## CAPIEL Inventory Methodology (2)

### Annual Assessment of SF<sub>6</sub>- Quantities for all Partners



$$\frac{n \times (\text{SF}_6 \text{ Input} - \text{SF}_6 \text{ Output} \pm \text{Delta Stock})}{= \text{total SF}_6 \text{ Emission}}$$

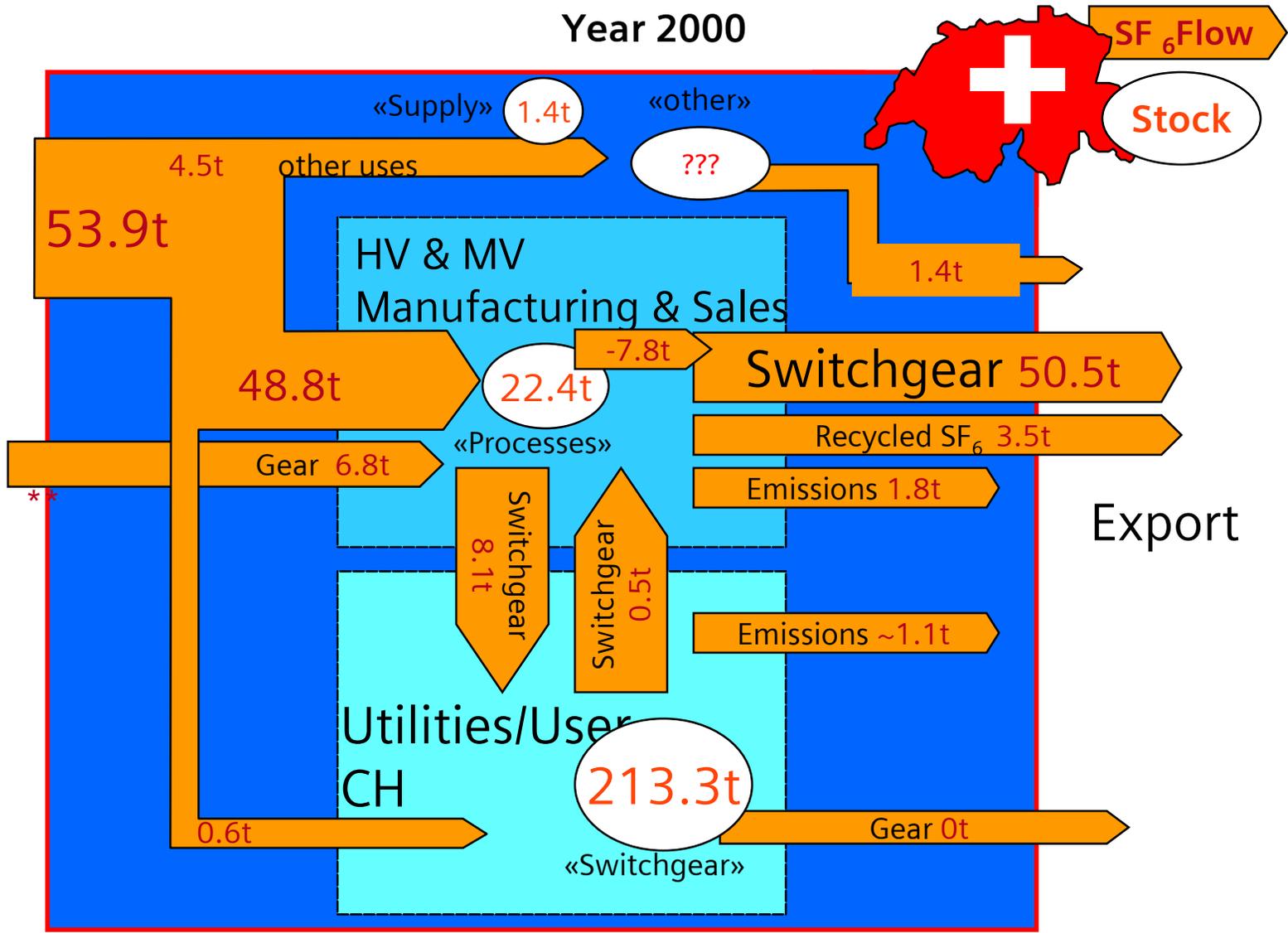
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# Inventory Methodology: Example Switzerland

Year 2000



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# Switchgear Equipment Leakage (1)

1...< 52 kV

> 52 kV.....1000 kV



MV-sealed for life switchgear:  
leakage rate 0,1%...0.01% p.a.



Dead-Tank  
Circuit-Breaker 145 kV



Live-Tank  
Circuit-Breaker 300 kV

**MV switchgear:  
typical leakage rate < 0.1 % p.a.**

**HV switchgear:  
typical leakage rate < 0.5 % p.a.**

**CAPIEL commitment: Indication of SF<sub>6</sub> content on  
nameplate to support inventory-methodology and  
instruction for proper re-cycling and disposal**

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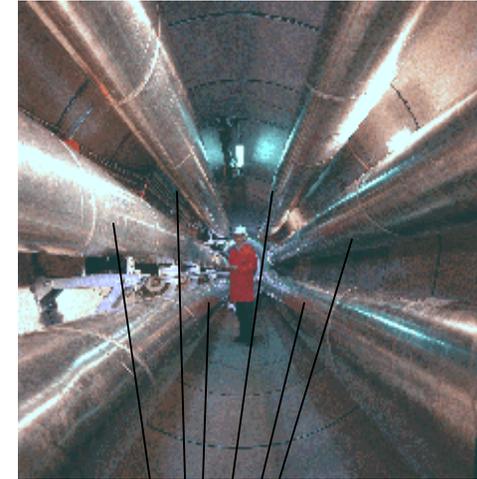
# Switchgear Equipment Leakage (2)

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Gas-Insulated Switchgear (GIS) 550 kV



Gas-Insulated Line 420/550 kV

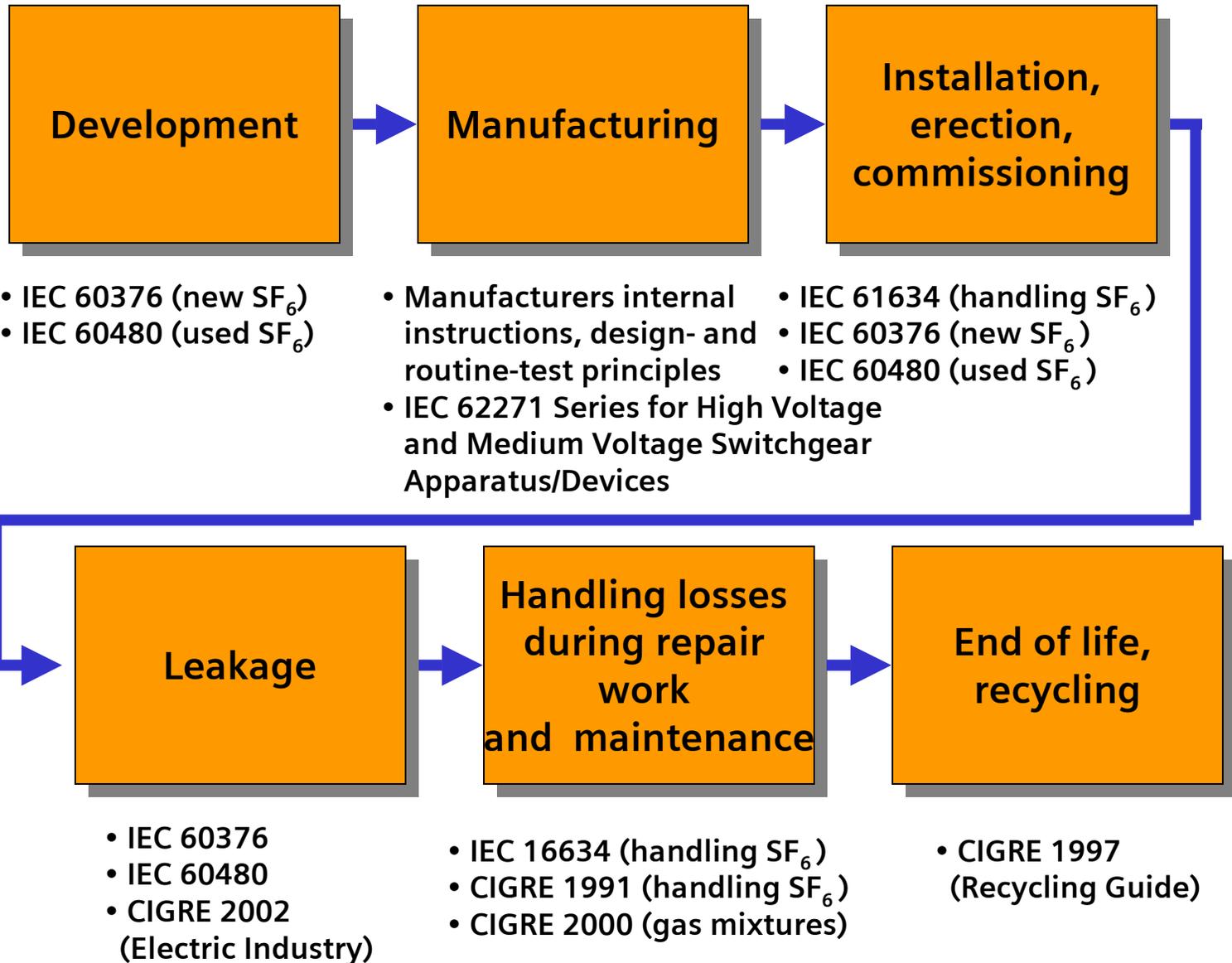


Highly-Integrated Switchgear 145 kV/40 kA (Outdoor GIS)

SF<sub>6</sub> content on nameplate

HV switchgear:  
typical leakage rate < 0.5 % p.a.

# Switchgear standards referring to SF<sub>6</sub> - issues



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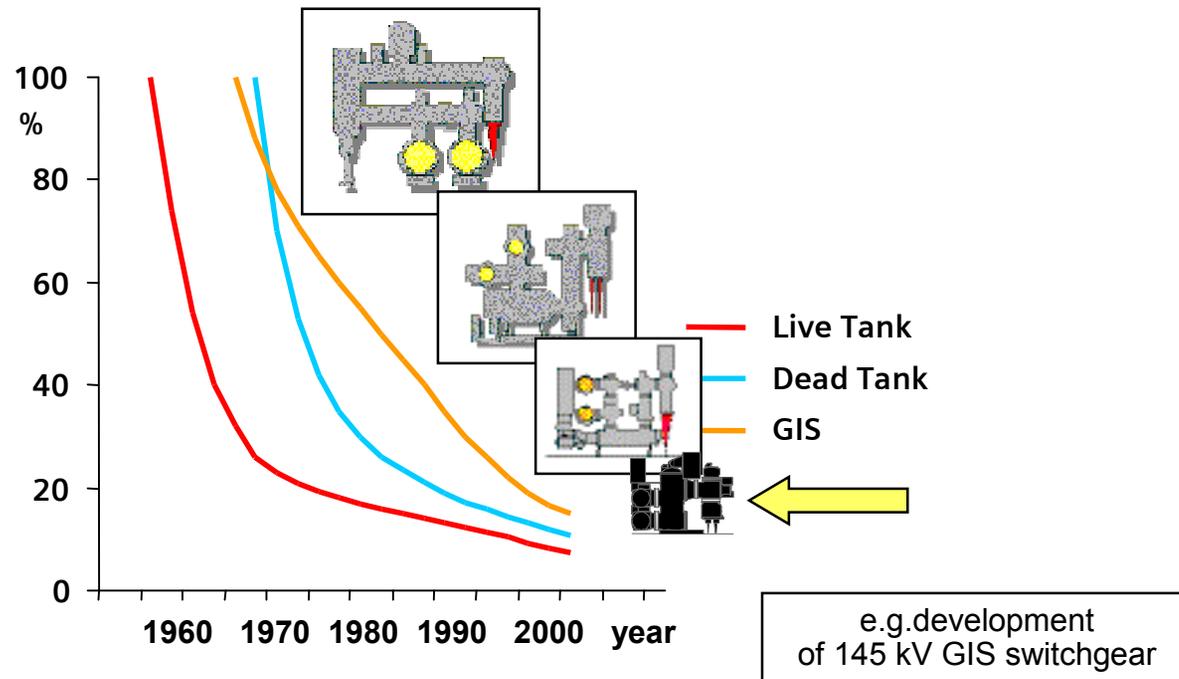
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# Development (1)

## Reduction of SF<sub>6</sub> quantities for switchgear was efficient



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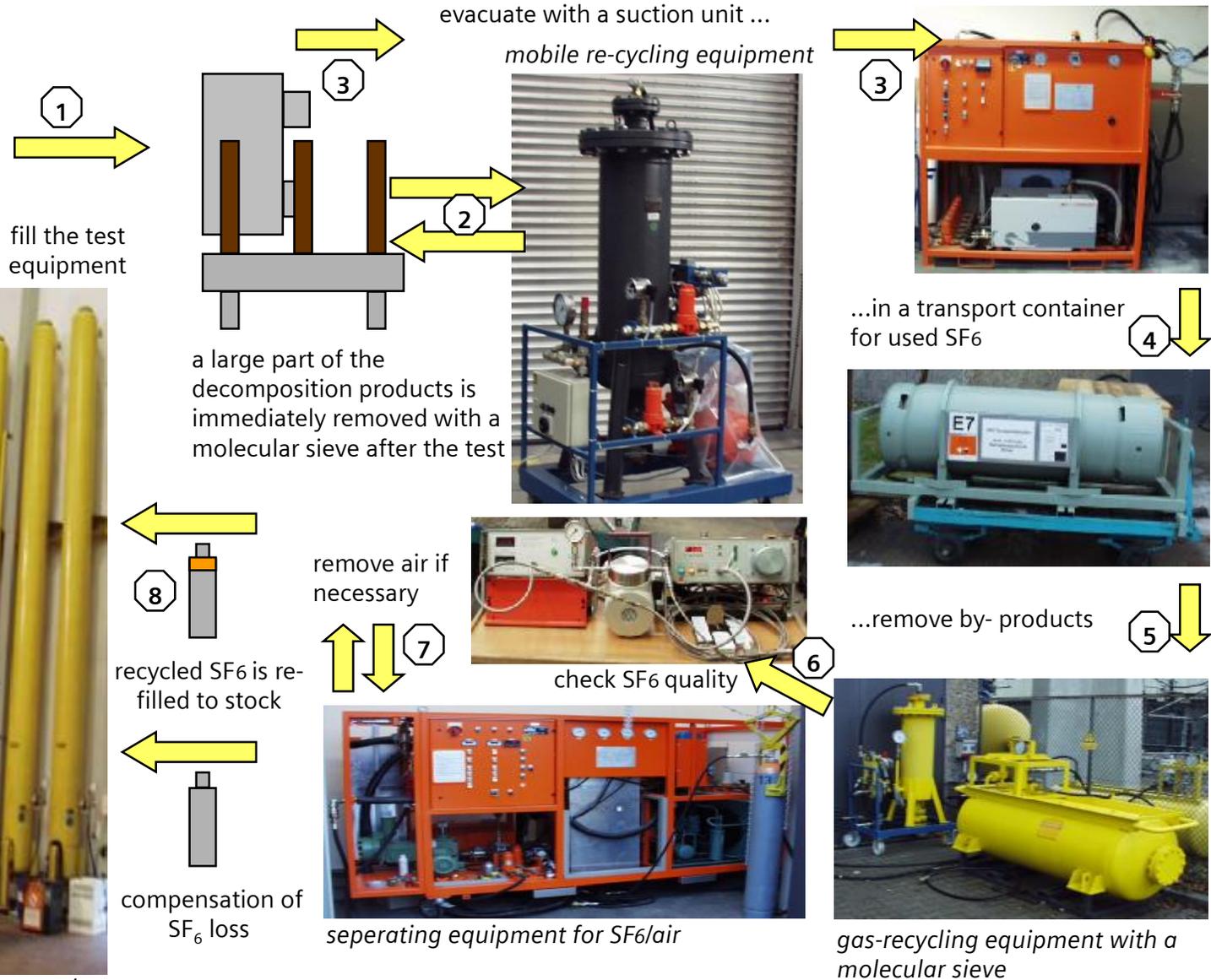
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# Equipment for using SF<sub>6</sub> in the Development (2)

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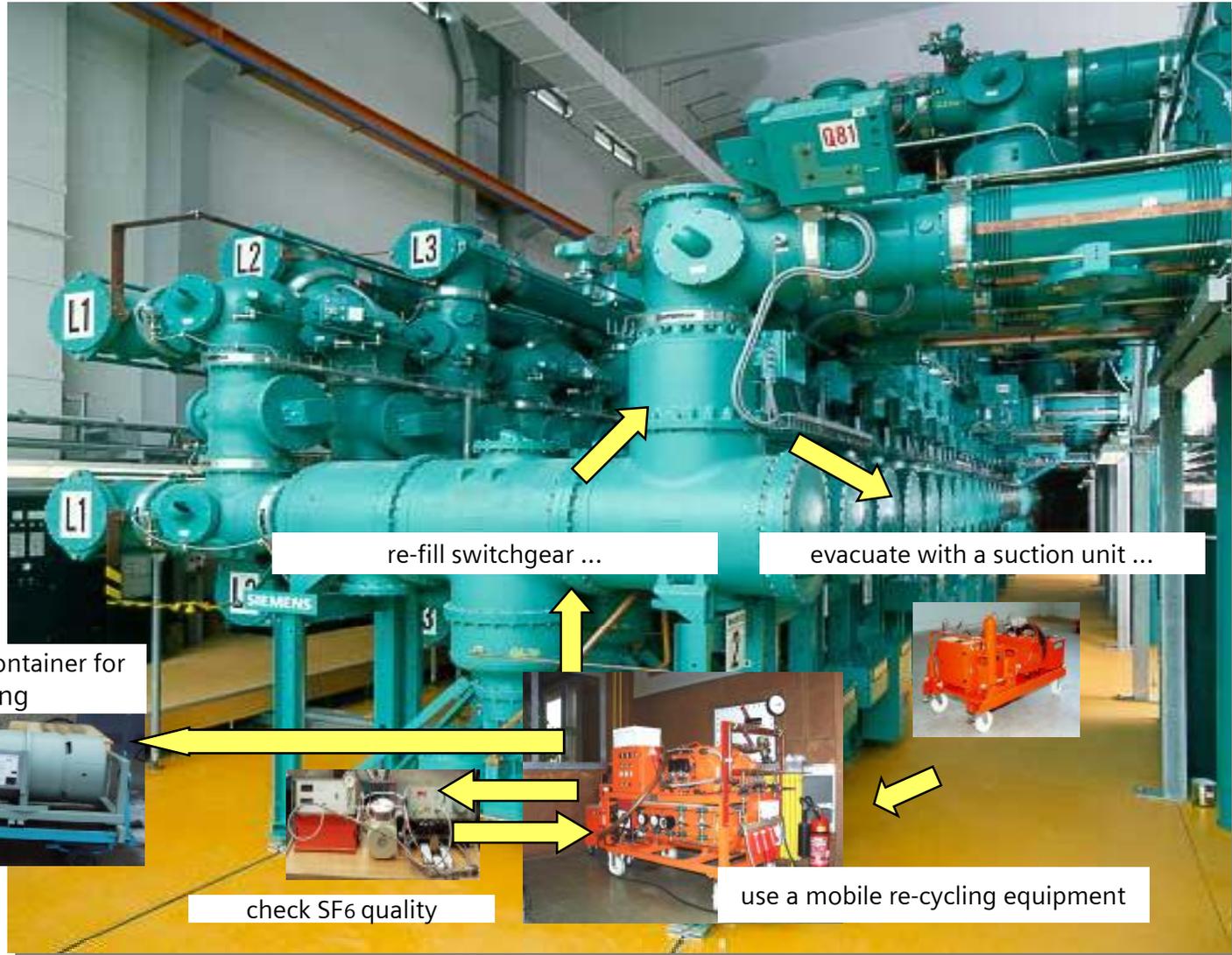
storage tank

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# Equipment for using SF<sub>6</sub> at substation

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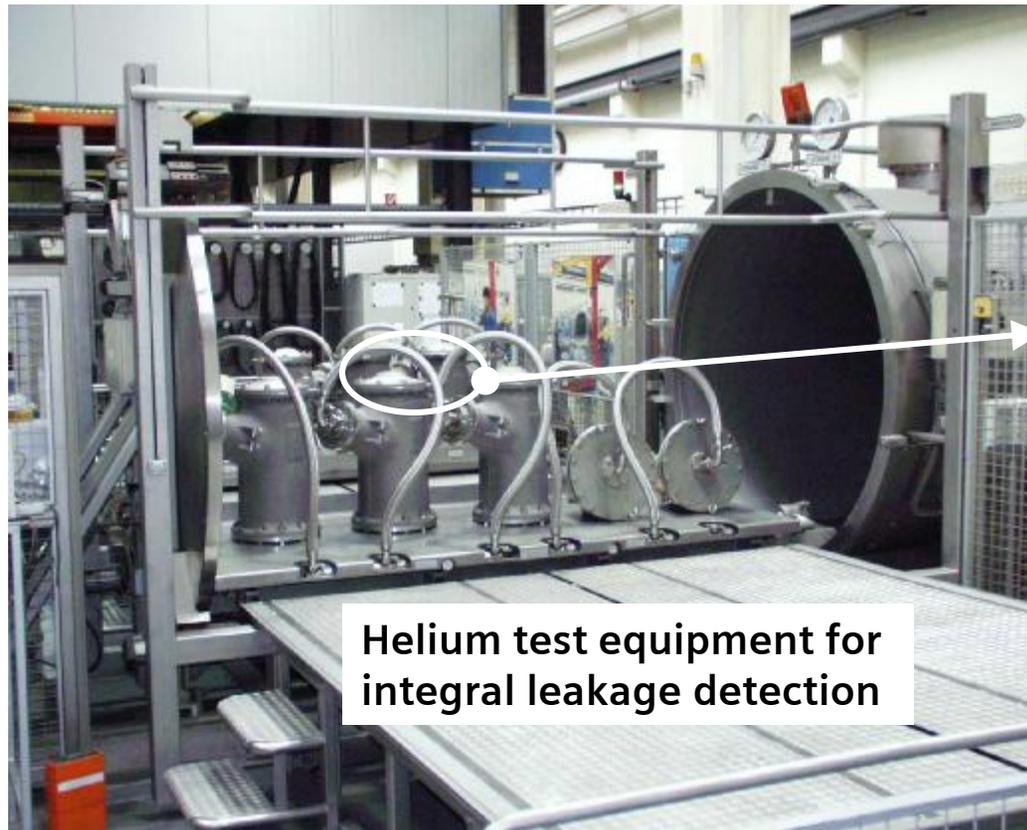
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# Manufacturing

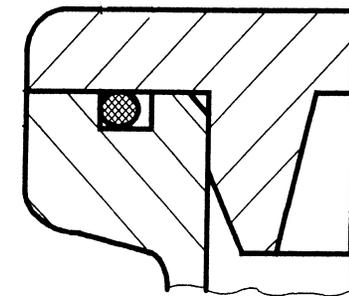
Routine test for all pressurized assemblies is mandatory

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Helium test equipment for  
integral leakage detection

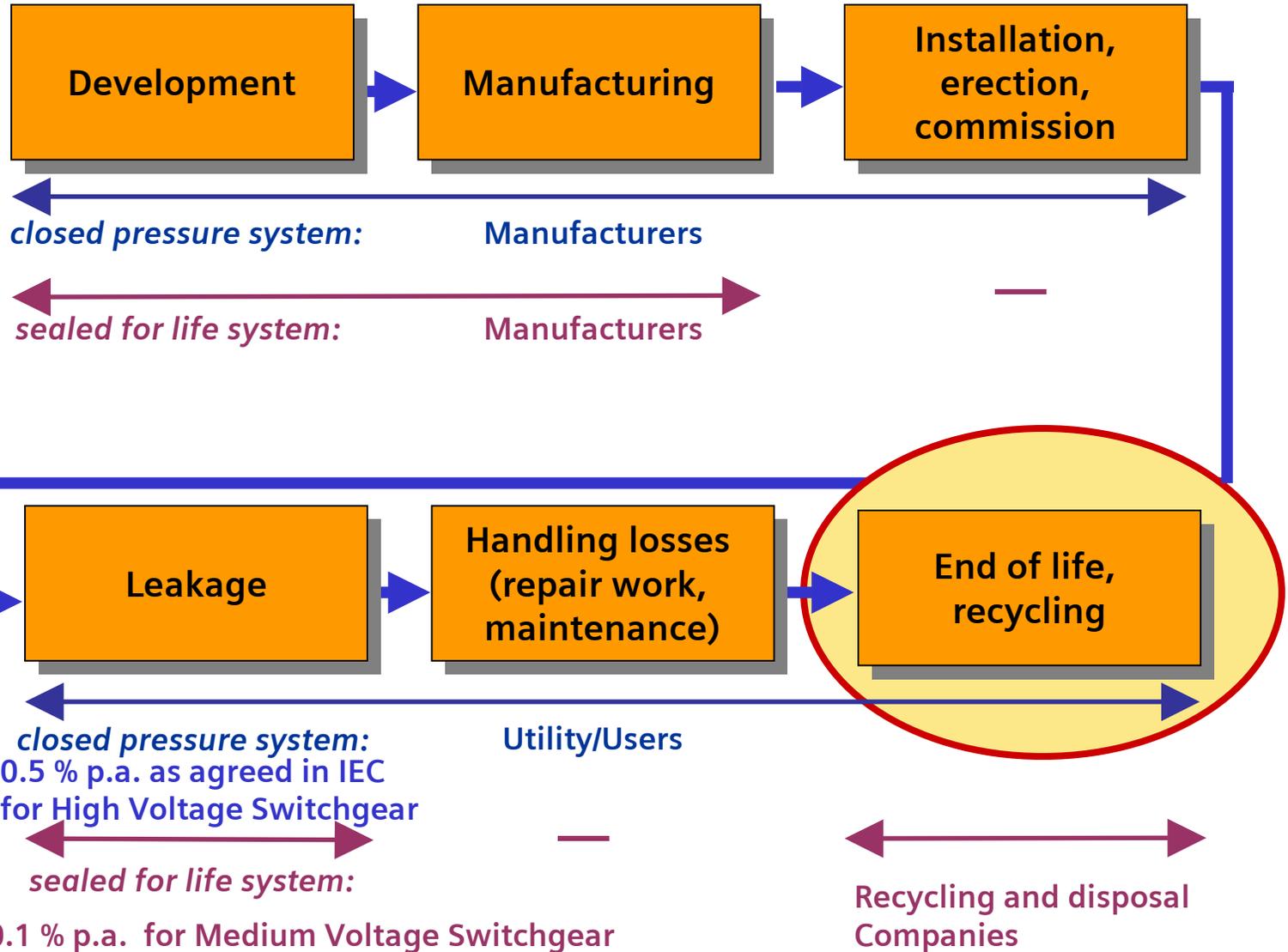


Sealing design

# Responsibility Flowchart for SF<sub>6</sub> Monitoring

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CAPIEL Technical Commission Draft 02/11/14 19



# SF<sub>6</sub> Emission Reduction in the Switchgear Industry

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- Avoid unnecessary transport of SF<sub>6</sub>
- Promote concept of re-use of SF<sub>6</sub>
- Ensure re-use in relevant standards:
  - IEC 60480 presently under revision
  - IEC 62271series
- Promote use of appropriate handling equipment, ensuring low emissions and re-use of the SF<sub>6</sub>
- Promote setting up SF<sub>6</sub> handling/storage ventures, country organization wise



## Improvement for total Electricity Industry

**Manufacturers are requested to lead development of a sustained End of Life Concept:**

- **Utilities participate in existing voluntary agreements**
- **Non-utility users shall also be instructed by manufacturers on proper recycling/disposal.**
- **Extension of existing voluntary agreement to total Electricity Sector (manufacturers and users)**

**Possible solution:**

- **Partnership agreement between government and Electricity Sector (in accordance with voluntary inventory system for switchgear equipment); actual focus: improved process for SF<sub>6</sub> - recycling.**

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## Conclusions (1)

- The CAPIEL Inventory Methodology was developed in cooperation with EURELECTRIC and is established for electrical switchgear equipment in Europe.
- National inventories run successfully (i.e. Germany, Switzerland).
- Emissions are reduced and industry's voluntary action prove being effective.
- There is no need for governmental regulation - Industry acts responsibly.

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## Conclusions (2)

- If some users (utilities/non utilities) may not be covered reasonable estimates can be provided.
- Actual improvement efforts are addressed to de-commissioning and re-cycling.
- Extension to total Electricity Sector under discussion on national level.

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## Conclusions (3) Further detailed information

### CAPIEL- Environmental Sustainability Dossier

Part A	Part B	Part C	Part D
CAPIEL, Facts and Data	CAPIEL Environment Sustainability Approach	Environmental Impacts	Switchgear Industry and Environment Sustainability

- contains state of the art information
- is open to be adopted
- supports the SF<sub>6</sub> - emission control and - reduction

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